

MEASUREMENT REPORT

FCC PART 15.407 WLAN 802.11a/n/ac/ax

FCC ID: TE7RE605X

Applicant: TP-Link Technologies Co., Ltd.

Application Type: CLASS II PERMISSIVE CHANGE

Product: AX1800 Wi-Fi 6 Range Extender
AX1750 Wi-Fi 6 Range Extender

Model No.: RE605X, RE603X

Brand Name: tp-link

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Rule Part(s): Part15 Subpart E (Section 15.407)

Test Date: June 22 ~ August 08, 2020

Reviewed By:



(Paddy Chen)

Approved By:



(Chenz Ker)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02v02r01. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Taiwan) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2007TW0006-U4	Rev. 01	Initial report	11-04-2020	Valid

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General Information

Applicant:	TP-Link Technologies Co., Ltd.
Applicant Address:	Building 24 (floors 1,3,4,5) and 28 (floors1-4), Central Science and Technology Park, Nanshan Shenzhen, 518057 China
Manufacturer:	TP-Link Technologies Co., Ltd.
Manufacturer Address:	Building 24 (floors 1,3,4,5) and 28 (floors1-4), Central Science and Technology Park, Nanshan Shenzhen, 518057 China
Test Site:	MRT Technology (Taiwan) Co., Ltd
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- MRT facility is a FCC registered (Reg. No. 154292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.
- MRT facility is an IC registered (MRT Reg. No. 21723) test laboratory with the site description on file at Industry Canada.
- MRT Lab is accredited to ISO 17025 by the Taiwan Accreditation Foundation (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC (Designation Number: TW3261), Industry Taiwan, EU and TELEC Rules.

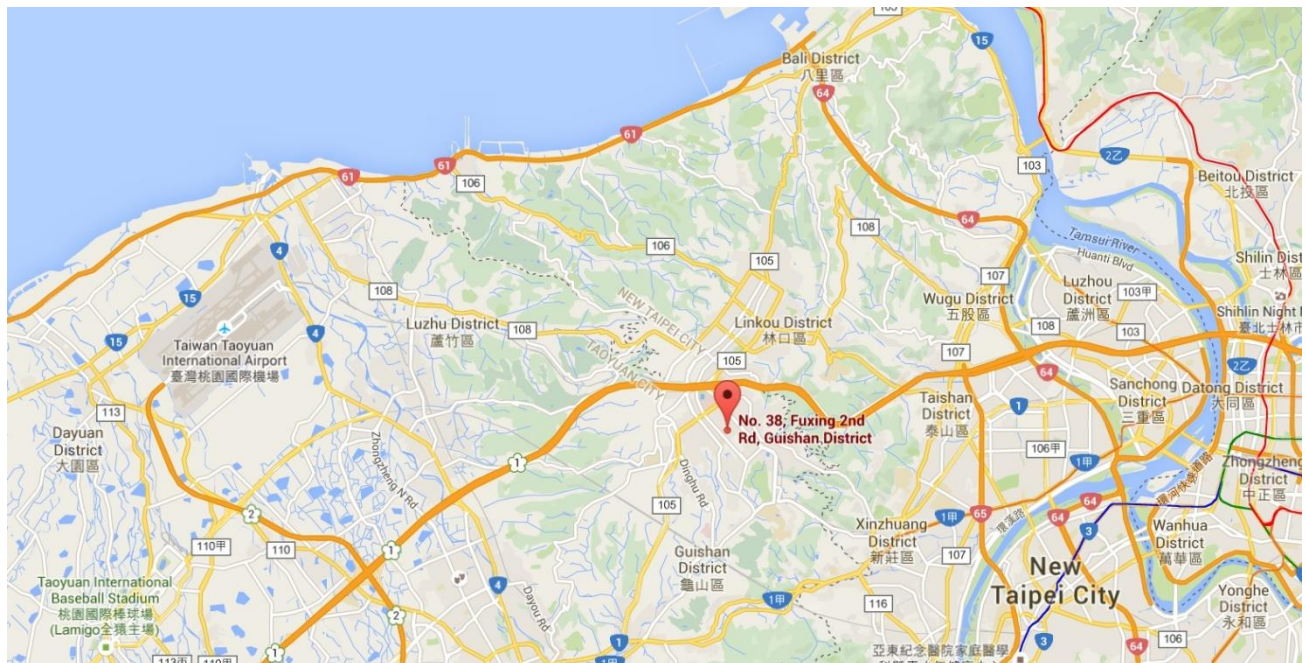
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name:	AX1800 Wi-Fi 6 Range Extender AX1750 Wi-Fi 6 Range Extender
Model No.:	RE605X, RE603X
Brand Name:	tp-link
Wi-Fi Specification:	802.11a/b/g/n/ac/ax
EUT Identification No.:	20200622Sample#08 (Conducted) 20200622Sample#07 (Radiated & AC conducted emission)

Note: There is the same hardware design, PCB layout between the models, different models and product names for different marketing requirements. Only RE605X (Product name: AX1800 Wi-Fi 6 Range Extender) was selected for final tests.

2.2. Product Specification Subjective to this Report

Frequency Range:	For 802.11a/n-HT20/ac-VHT20/ax-HE20: 5180~5240MHz, 5260~5320MHz, 5500~5720MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40/ax-HE40: 5190~5230MHz, 5270~5310MHz, 5510~5710MHz, 5755~5795MHz For 802.11ac-VHT80/ax-HE80: 5210MHz, 5290MHz, 5530MHz, 5610 MHz, 5690MHz, 5775MHz
Type of Modulation:	802.11a/n/ac: OFDM 802.11ax: OFDMA
Data Rate:	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.6Mbps 802.11ax: up to 1201Mbps

Note: For other features of this EUT, test report will be issued separately.

2.3. Working Frequencies for this report

802.11a/n-HT20/ac-VHT20/ax-HE20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	52	5260 MHz	56	5280 MHz
60	5300 MHz	64	5320 MHz	100	5500 MHz
104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz
128	5640 MHz	132	5660 MHz	136	5680 MHz
140	5700 MHz	144	5720 MHz	149	5745 MHz
153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	--	--	--	--

802.11n-HT40/ac-VHT40/ax-HE40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz
62	5310 MHz	102	5510 MHz	110	5550 MHz
118	5590 MHz	126	5630 MHz	134	5670 MHz
142	5710 MHz	151	5755 MHz	159	5795 MHz

802.11ac-VHT80/ax-HE80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	58	5290 MHz	106	5530 MHz
122	5610 MHz	138	5690 MHz	155	5775 MHz

2.4. Description of Available Antennas

Antenna Type	Frequency Band (MHz)	T _x Paths	Number of spatial streams	Max Antenna Gain (dBi)	Beamforming Directional Gain (dBi)	CDD Directional Gain (dBi)	
						For Power	For PSD
Dipole Antenna	2412 ~ 2462	2	1	1.99	5.00	1.99	5.00
	5150 ~ 5250	2	1	1.98	4.99	1.98	4.99
	5250 ~ 5350	2	1	2.99	6.00	2.99	6.00
	5470 ~ 5725	2	1	2.46	5.47	2.46	5.47
	5725 ~ 5850	2	1	2.13	5.14	2.13	5.14

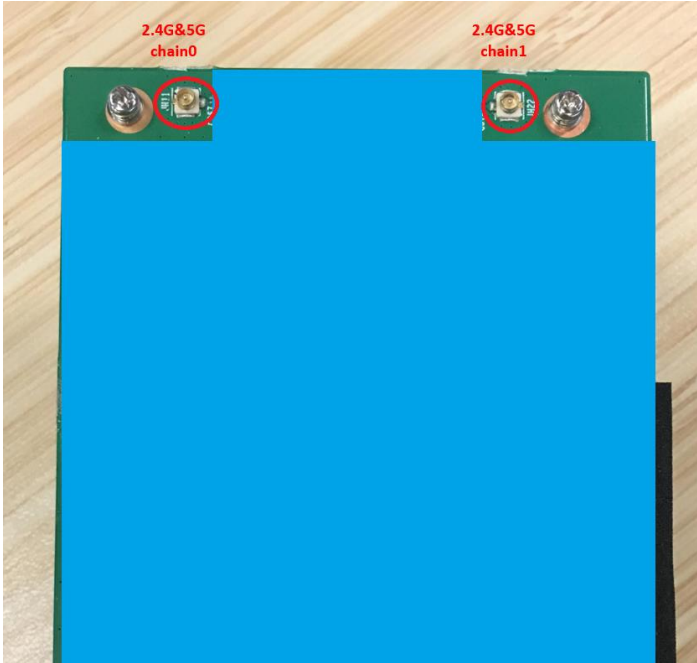
Note

1. The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

If all antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
Array Gain = $10 \log (N_{ANT} / N_{SS})$ dB;
 - For power measurements on IEEE 802.11 devices,
Array Gain = 0 dB for $N_{ANT} \leq 4$;
2. The EUT also supports Beam Forming mode, and the Beam Forming support 802.11ac/ax, not include 802.11a/b/g/n. BF Directional gain = $G_{ANT} + 10 \log (N_{ANT})$.
 3. All messages as above were declared by manufacturer.

2.5. Description of Antenna RF Port

Antenna RF Port				
Software Control Port	2.4GHz RF Port		5GHz RF Port	
	Ant 0	Ant 1	Ant 0	Ant 1
				

2.6. Test Mode

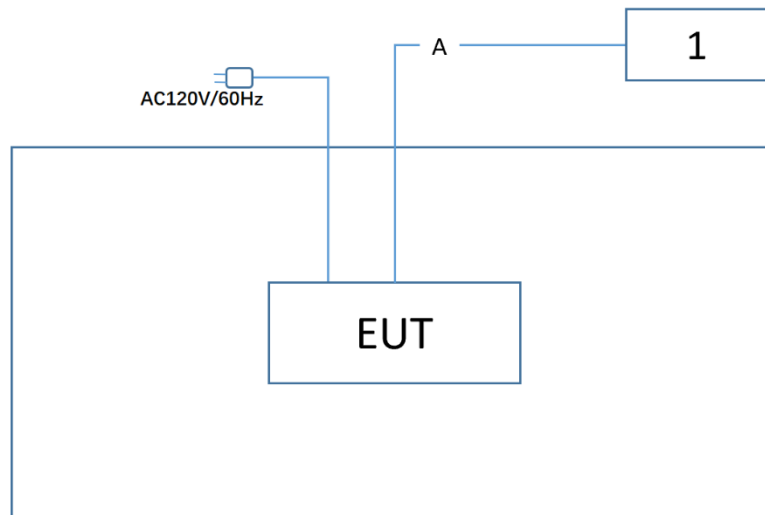
Test Mode	Mode 1: Transmit by 802.11a (6Mbps) (CDD mode)
	Mode 2: Transmit by 802.11ac-VHT20 (MCS0) (CDD mode)
	Mode 3: Transmit by 802.11ac-VHT40 (MCS0) (CDD mode)
	Mode 4: Transmit by 802.11ac-VHT80 (MCS0) (CDD mode)
	Mode 5: Transmit by 802.11ax-HE20 (MCS0) (CDD mode)
	Mode 6: Transmit by 802.11ax-HE40 (MCS0) (CDD mode)
	Mode 7: Transmit by 802.11ax-HE80 (MCS0) (CDD mode)
	Mode 8: Transmit by 802.11ac-VHT20 (MCS0) (Beam-Forming mode)
	Mode 9: Transmit by 802.11ac-VHT40 (MCS0) (Beam-Forming mode)
	Mode 10: Transmit by 802.11ac-VHT80 (MCS0) (Beam-Forming mode)
	Mode 11: Transmit by 802.11ax-HE20 (MCS0) (Beam-Forming mode)
	Mode 12: Transmit by 802.11ax-HE40 (MCS0) (Beam-Forming mode)
	Mode 13: Transmit by 802.11ax-HE80 (MCS0) (Beam-Forming mode)

Note: Due to the same modulation between 802.11n and 802.11ac, so 802.11n-HT20 and HT40 are covered by 802.11ac-VHT20 and VHT40 in this report, meanwhile, power setting for 802.11n-HT20 and HT40 will not be greater than 802.11ac-VHT20 and VHT40.

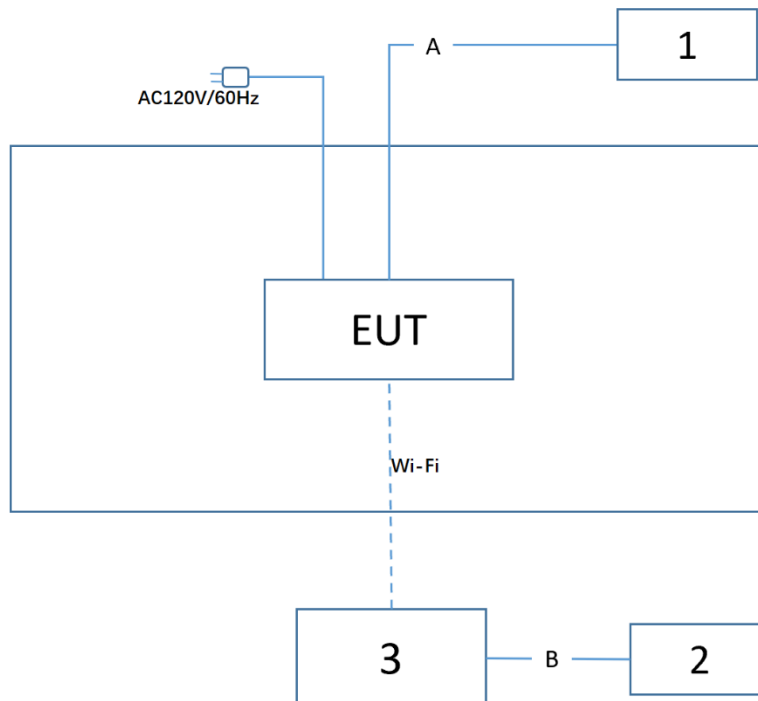
2.7. Configuration of Test System

The measurement procedures and appropriate EUT setup described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and KDB 789033 were used in the measurement.

Connection Diagram – Radiated Emission testing (CDD mode) & AC Conducted Emissions



Connection Diagram – Radiated Emission testing (Beam-Forming mode)



Signal Cable Type		Signal Cable Description
A	LAN Cable	Non shielded, > 10m
B	LAN Cable	Non shielded, 3.0m

2.8. Test System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord
1 Notebook	Lenovo	E431	PF-10ZRN 13/12	Non-Shielded, 1.8m
2 Notebook	Lenovo	X230i	N/A	Non-Shielded, 1.8m
3 Station Device	tp-link	RE605X	N/A	N/A

2.9. Description of Test Software

For CDD mode:

The test utility software used during testing was “accessMTool.exe”, the version is ver3.0.0.6.

For Beamforming mode:

Conducted measurement

The test utility software used during testing was “accessMTool.exe”, the version is ver3.0.0.6.

Radiated measurement

- 1) Configure EUT and station device to under the normal operation.
- 2) Set and fix EUT’s mode, channel, and power by telnet.
- 3) Connect EUT with station device, run “lperf. exe” to transmit and receive packet continuously by station device.

Note: Final power setting please refer to operational description.

2.10. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part15 Subpart E (Section 15.407)
- ANSI C63.10-2013
- KDB 789033 D02v02r01
- KDB 662911 D01v02r01

2.11. Test Environment Condition

Ambient Temperature	15°C~35°C
Relative Humidity	20%RH ~75%RH

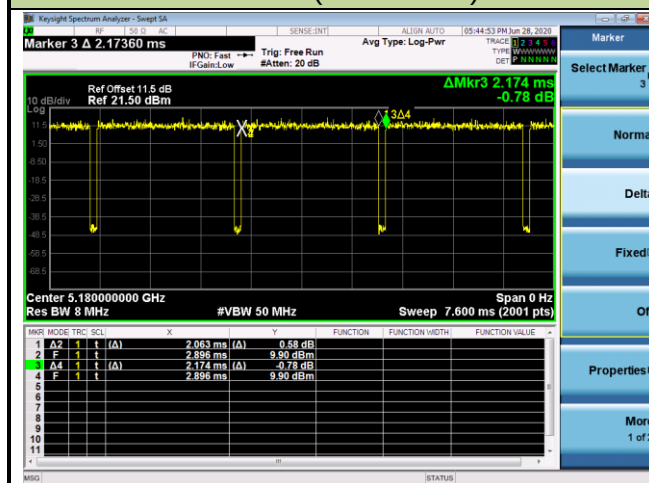
2.12. Duty Cycle

5GHz (NII) operation is possible in 20MHz, 40MHz and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

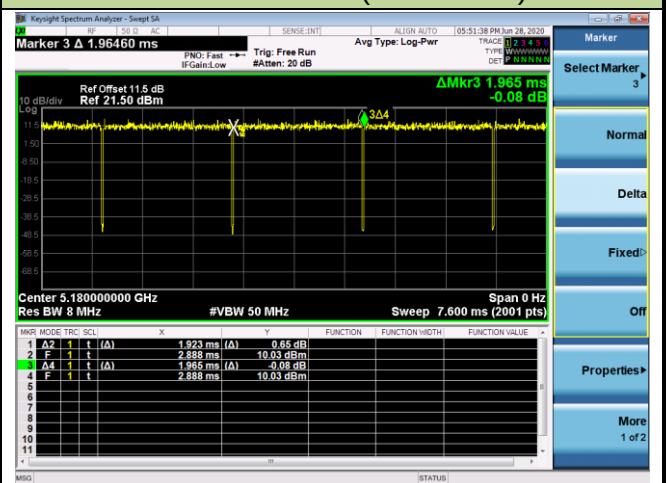
Test Mode	Duty Cycle
802.11a	94.89%
802.11ac-VHT20	97.86%
802.11ac-VHT40	95.59%
802.11ac-VHT80	93.87%
802.11ax-HE20	98.02%
802.11ax-HE40	96.00%
802.11ax-HE80	92.58%

Duty Cycle (T = Transmission Duration)

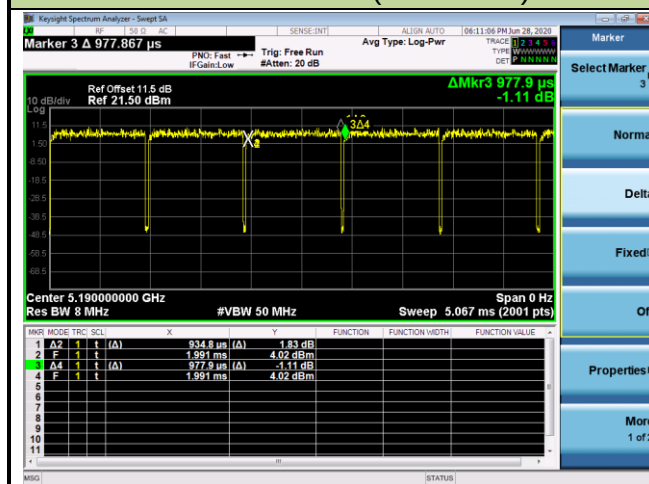
802.11a (T=2.063ms)



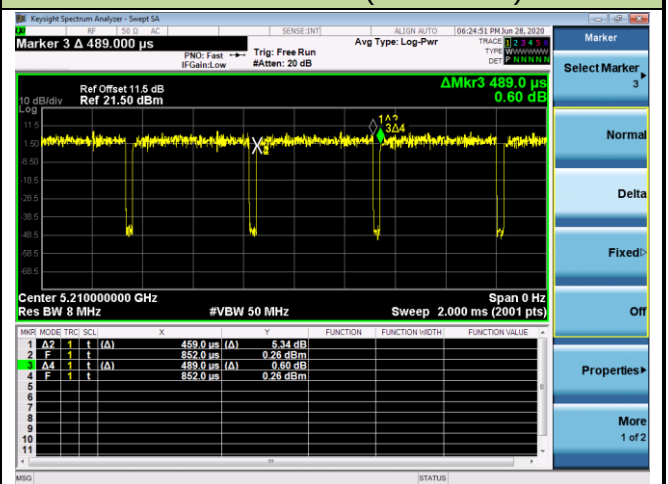
802.11ac-VHT20(T=1.923ms)

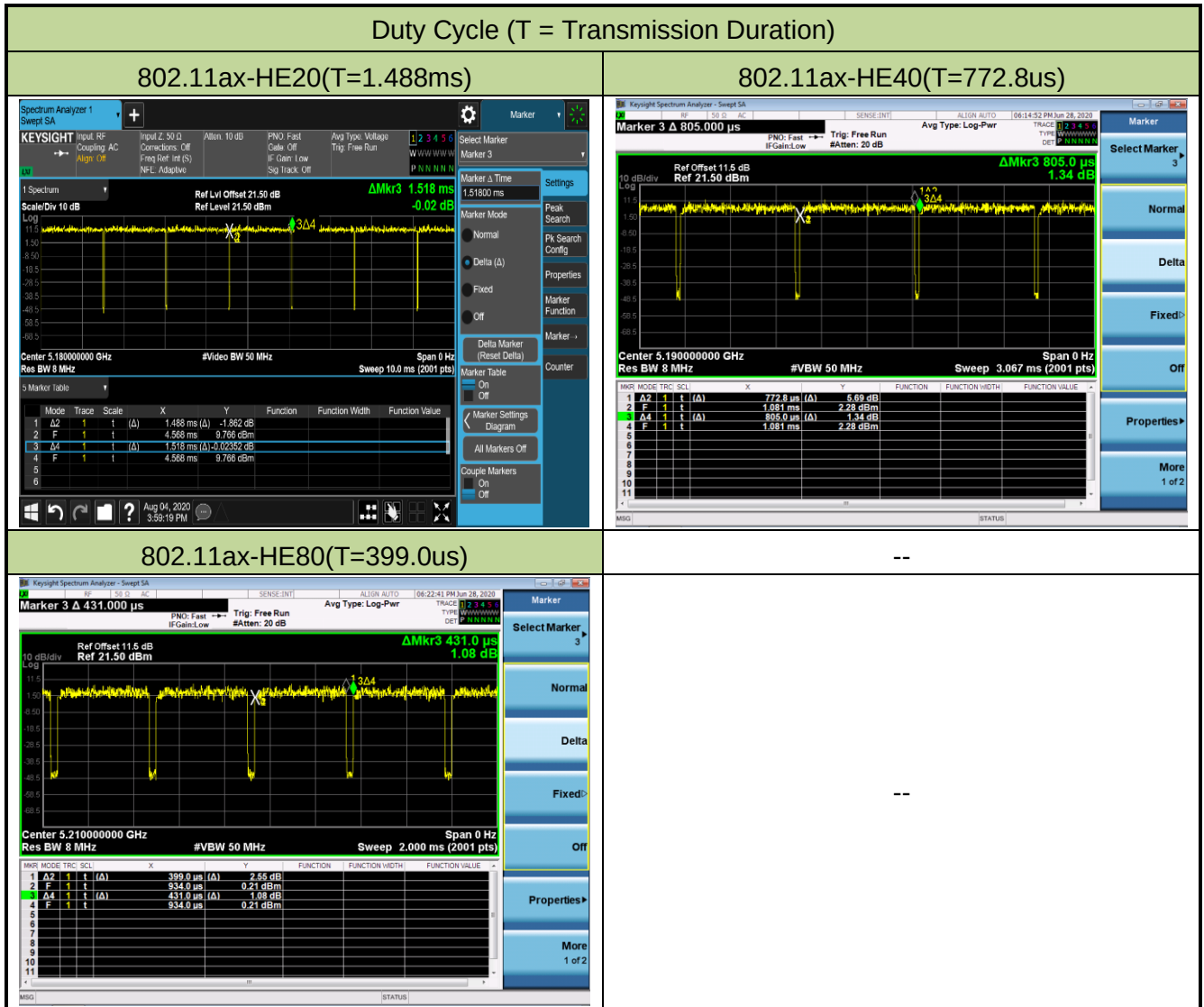


802.11ac-VHT40(T=934.8us)



802.11ac-VHT80(T=459.0us)





2.13. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.14. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase.

However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antenna of the device is **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The unit complies with the requirement of §15.203.

4. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2021/03/26
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2021/04/24
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2021/05/26
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2021/05/28

Radiated Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2021/10/05
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2021/04/27
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2021/04/24
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2021/04/24
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2021/04/24
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2021/04/24
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2021/03/24
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2021/03/25
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2020/11/02
Antenna Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2021/06/16
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00032	1 year	2021/05/28

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2021/04/24
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2020/11/02
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/07/11
Attenuator	WTI	218FS-20	MRTTWE00026	1 year	2021/05/30
Attenuator	WTI	218FS-10	MRTTWE00027	1 year	2021/05/30
Attenuator	WTI	218FS-06	MRTTWE00028	1 year	2021/05/30
Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2021/06/10
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2021/05/28

Software	Version	Function
e3	9.160520a	EMI Test Software

5. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 150kHz~30MHz: 2.53dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 9kHz ~ 1GHz: 4.25dB 1GHz ~ 40GHz: 4.45dB
Conducted Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): ± 0.84 dB
Conducted Spurious Emission
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): ± 2.65 dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 3.3%
Temp. / Humidity
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): $\pm 0.82^\circ\text{C}$ / $\pm 3\%$
Frequency Error
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): ± 78.4 Hz

6. TEST RESULT

6.1. Summary

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 6.2
15.407(a)(2)	Maximum Conducted Output Power	Refer to Section 6.4		Pass	Section 6.3
15.407(h)(1)	Transmit Power Control	≤ 24 dBm		Pass	Section 6.4
15.407(a)(2)	Peak Power Spectral Density	Refer to Section 6.5		Pass	Section 6.5
15.407(g)	Frequency Stability	± 20 ppm		Pass	Section 6.6
15.407(b)(2), (3)	Undesirable Emissions	Refer to Section 6.7	Radiated	Pass	Section 6.7 & 6.8
15.205, 15.209 15.407(b)(7), (8), (9)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 6.9

Notes:

- The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- Output power test was verified over all data rates of each mode (data refers to operational description), and then choose the maximum power output (low data rate) for final test of each channel.
- For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.
- Test Items "26dB Bandwidth" & "6dB Bandwidth" showed the worst test data in this report.
- EUT supports one configuration only in 802.11ax full RU mode, i.e. 242 tone in 11ax-HE20, 484 tone in 11ax-HE40 and 996 tone in 11ax-HE80.

6.2. 26dB Bandwidth Measurement

6.2.1.Test Limit

N/A

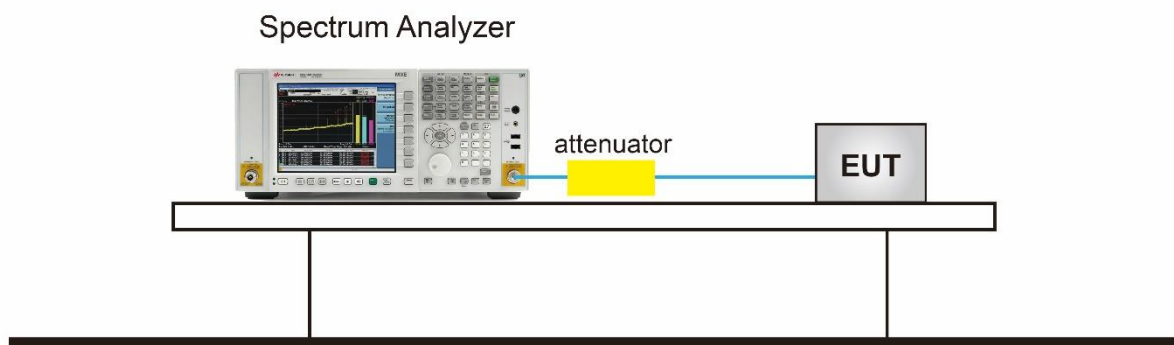
6.2.2.Test Procedure used

KDB 789033 D02v02r01- Section C.1

6.2.3.Test Setting

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 26$. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth.
3. VBW $\geq 3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold.

6.2.4.Test Setup



6.2.5.Test Result

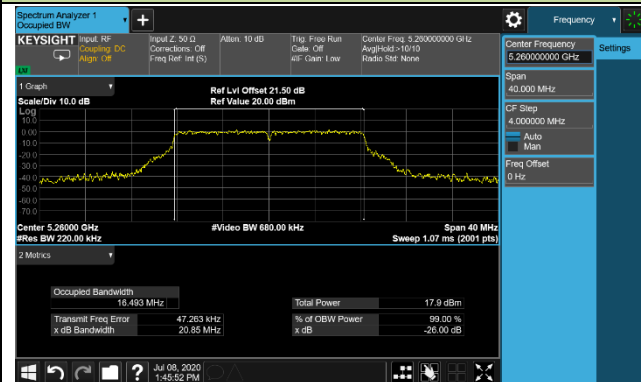
Product	AX1800 Wi-Fi 6 Range Extender	Test Engineer	Eric Lin
Test Site	SR1	Test Date	2020/07/08

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0 / Ant 0 + 1					
802.11a	6Mbps	52	5260	20.85	16.49
802.11a	6Mbps	60	5300	20.89	16.53
802.11a	6Mbps	64	5320	20.24	16.51
802.11a	6Mbps	100	5500	20.37	16.51
802.11a	6Mbps	116	5580	20.63	16.50
802.11a	6Mbps	140	5700	20.62	16.52
802.11a	6Mbps	144	5720	20.74	16.49
802.11ac-VHT20	MCS0	52	5260	21.05	17.72
802.11ac-VHT20	MCS0	60	5300	20.80	17.72
802.11ac-VHT20	MCS0	64	5320	21.25	17.72
802.11ac-VHT20	MCS0	100	5500	21.07	17.71
802.11ac-VHT20	MCS0	116	5580	20.96	17.72
802.11ac-VHT20	MCS0	140	5700	20.86	17.71
802.11ac-VHT20	MCS0	144	5720	20.83	17.74
802.11ac-VHT40	MCS0	54	5270	44.93	36.34
802.11ac-VHT40	MCS0	62	5310	38.61	36.22
802.11ac-VHT40	MCS0	102	5510	38.87	36.23
802.11ac-VHT40	MCS0	110	5550	39.41	36.26
802.11ac-VHT40	MCS0	134	5670	38.66	36.23
802.11ac-VHT40	MCS0	142	5710	42.92	36.26
802.11ac-VHT80	MCS0	58	5290	79.63	75.72
802.11ac-VHT80	MCS0	106	5530	81.19	75.61
802.11ac-VHT80	MCS0	122	5610	117.3	76.21
802.11ac-VHT80	MCS0	138	5690	148.7	77.45

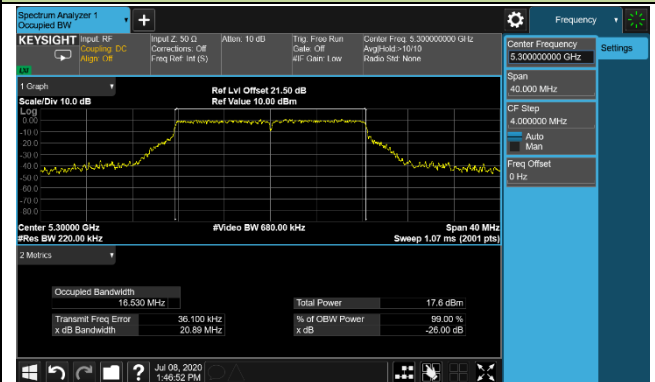
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0 / Ant 0 + 1					
802.11ax-HE20	MCS0	52	5260	21.76	19.03
802.11ax-HE20	MCS0	60	5300	21.43	19.04
802.11ax-HE20	MCS0	64	5320	21.47	19.03
802.11ax-HE20	MCS0	100	5500	20.93	19.00
802.11ax-HE20	MCS0	116	5580	20.96	19.04
802.11ax-HE20	MCS0	140	5700	21.35	18.97
802.11ax-HE20	MCS0	144	5720	21.43	19.07
802.11ax-HE40	MCS0	54	5270	47.40	37.76
802.11ax-HE40	MCS0	62	5310	39.68	37.61
802.11ax-HE40	MCS0	102	5510	39.35	37.62
802.11ax-HE40	MCS0	110	5550	47.57	37.72
802.11ax-HE40	MCS0	134	5670	39.47	37.59
802.11ax-HE40	MCS0	142	5710	54.73	37.80
802.11ax-HE80	MCS0	58	5290	81.42	77.05
802.11ax-HE80	MCS0	106	5530	61.35	76.85
802.11ax-HE80	MCS0	122	5610	81.12	77.32
802.11ax-HE80	MCS0	138	5690	153.2	79.17

802.11a 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

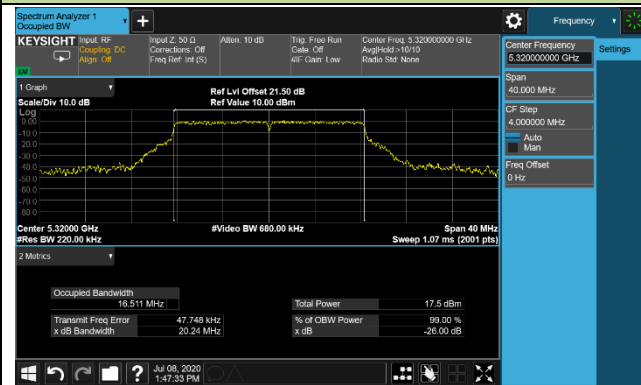
Channel 52 (5260MHz)



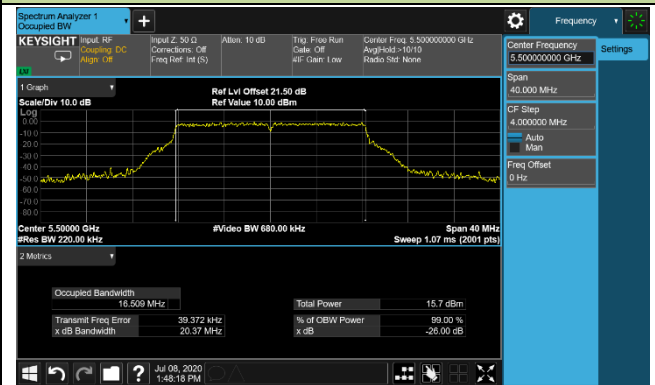
Channel 60 (5300MHz)



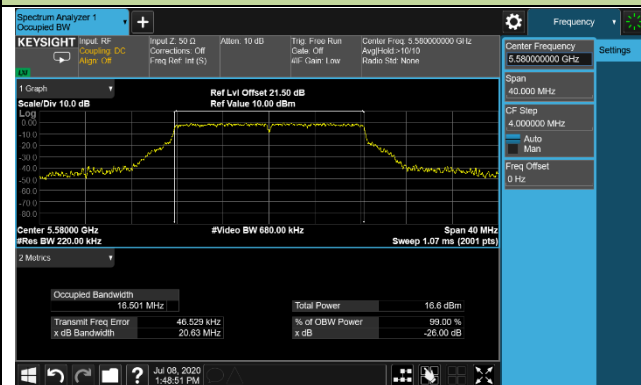
Channel 64 (5320MHz)



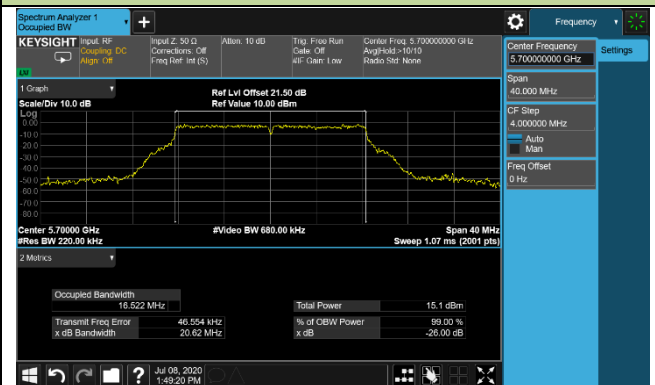
Channel 100 (5500MHz)



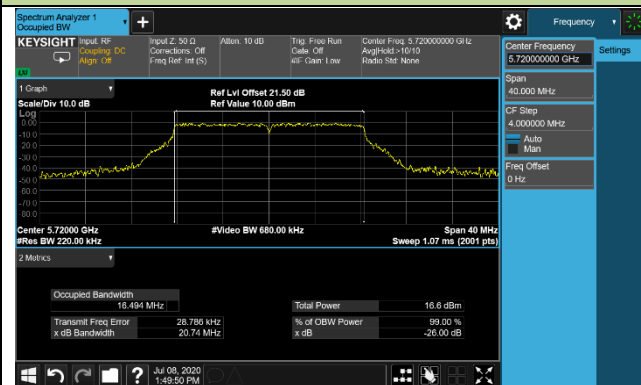
Channel 116 (5580MHz)



Channel 140 (5700MHz)

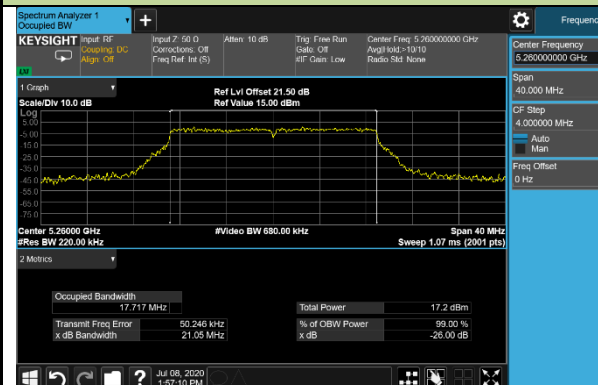


Channel 144 (5720MHz)

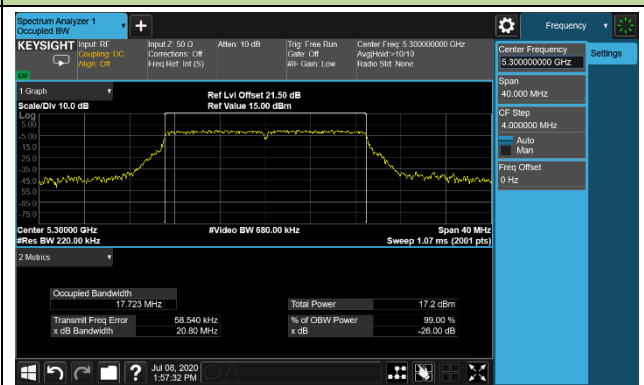


802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

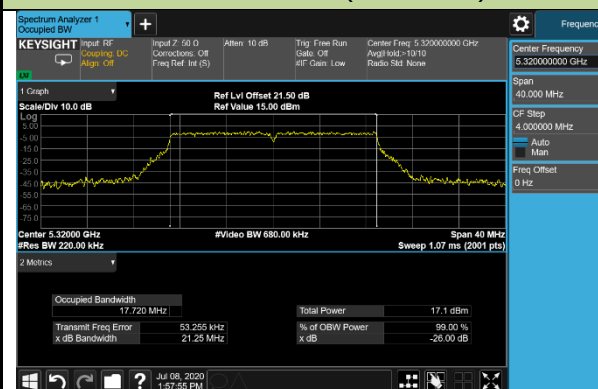
Channel 52 (5260MHz)



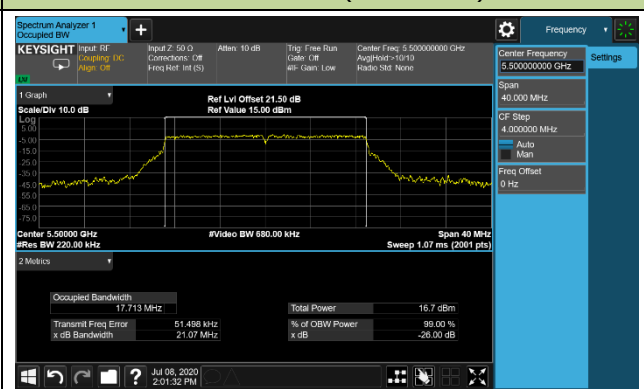
Channel 60 (5300MHz)



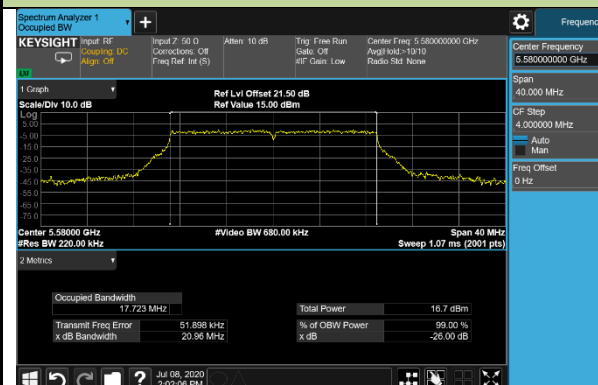
Channel 64 (5320MHz)



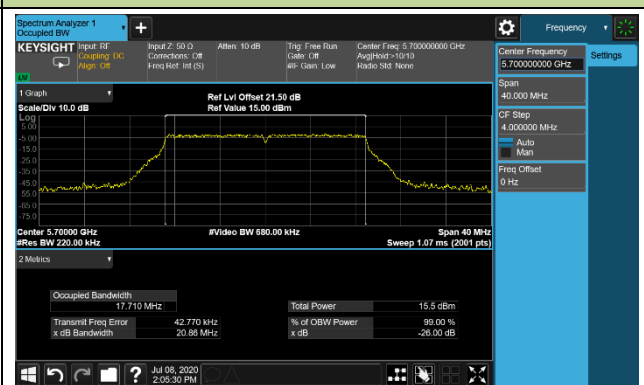
Channel 100 (5500MHz)



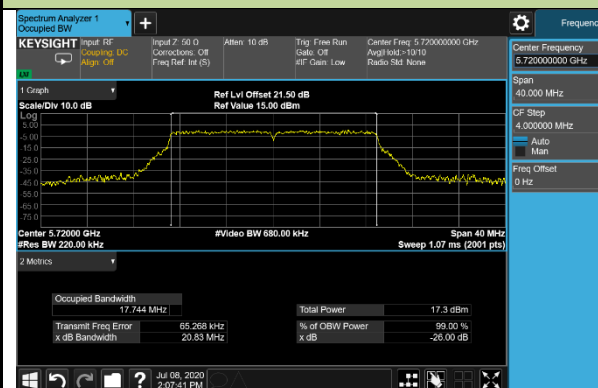
Channel 116 (5580MHz)



Channel 140 (5700MHz)

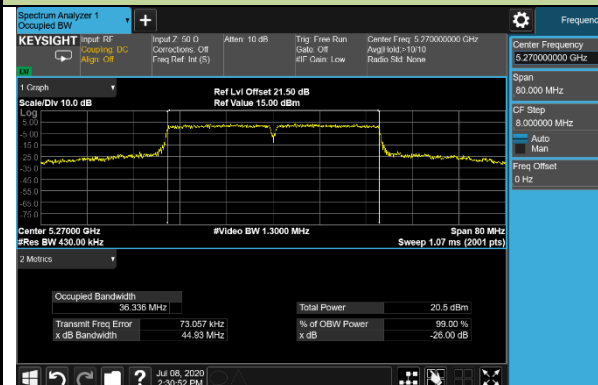


Channel 144 (5720MHz)

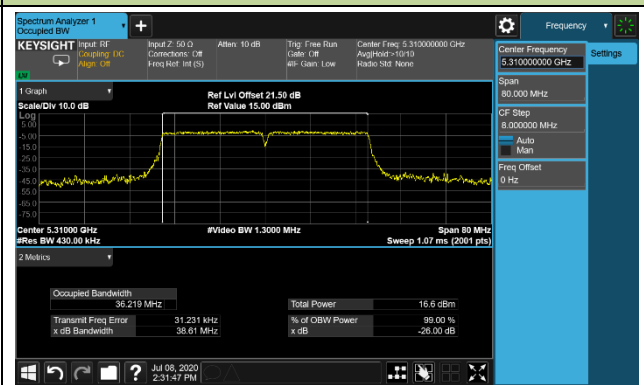


802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

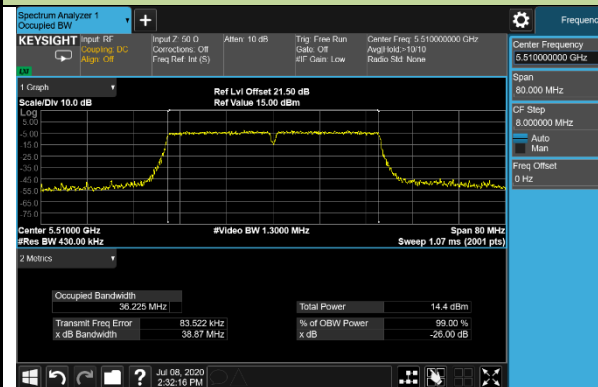
Channel 54 (5270MHz)



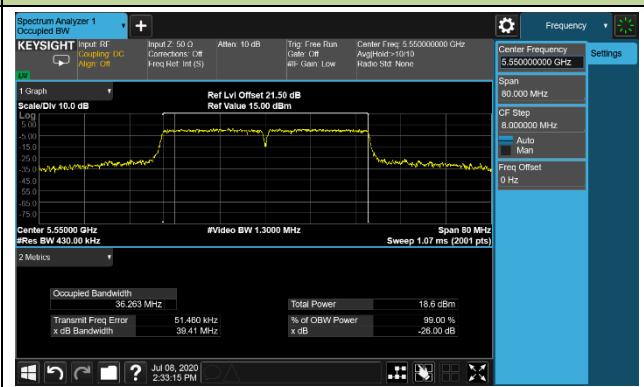
Channel 62 (5310MHz)



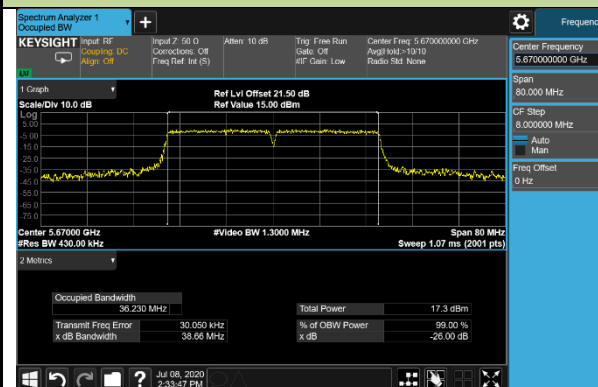
Channel 102 (5510MHz)



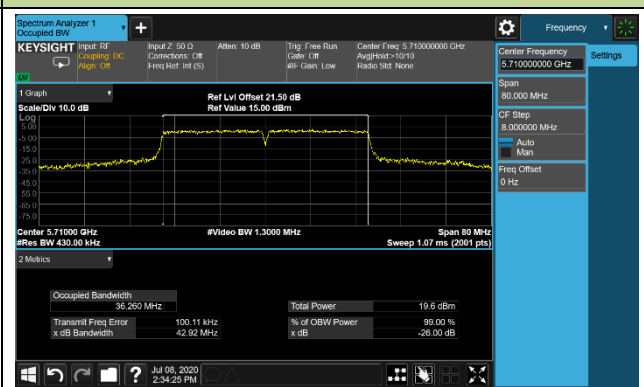
Channel 110 (5550MHz)



Channel 134 (5670MHz)

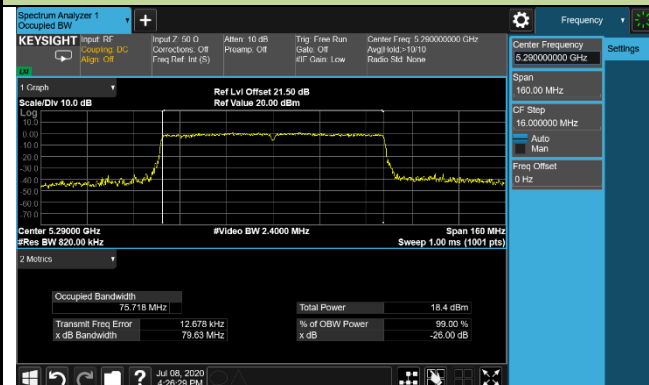


Channel 142 (5710MHz)

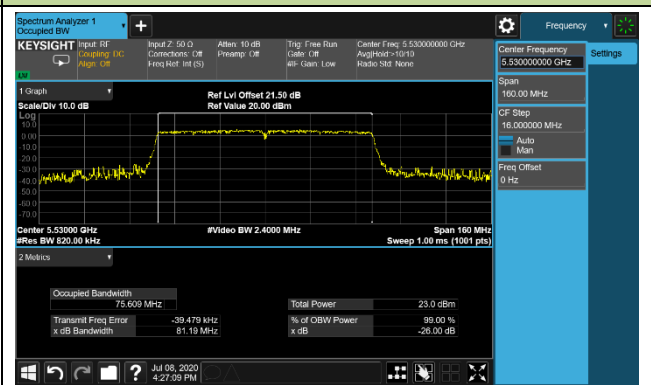


802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

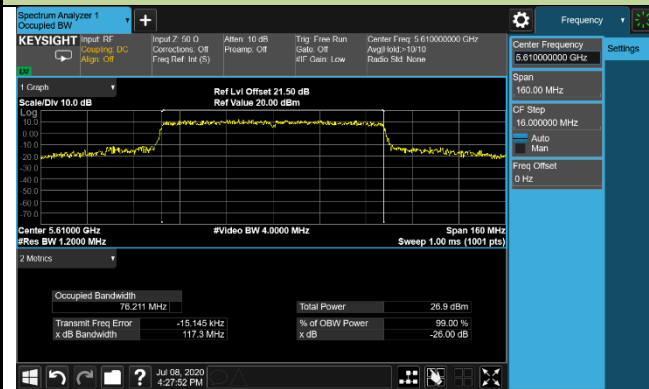
Channel 58 (5290MHz)



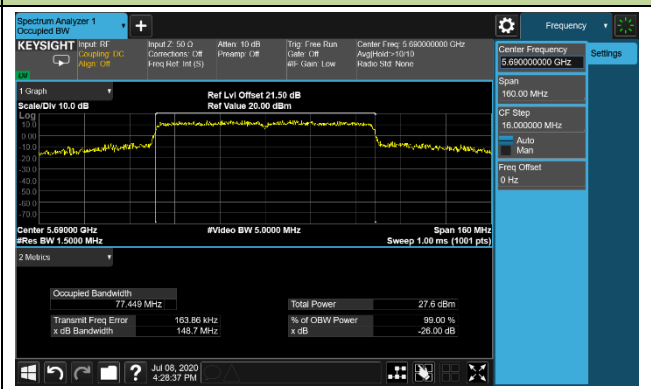
Channel 106 (5530MHz)



Channel 122 (5610MHz)

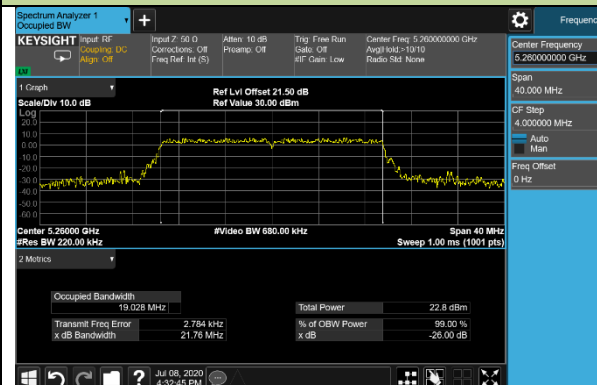


Channel 138 (5690MHz)

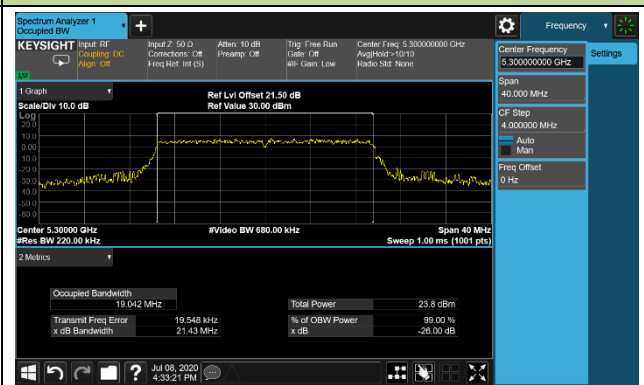


802.11ax-HE20 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

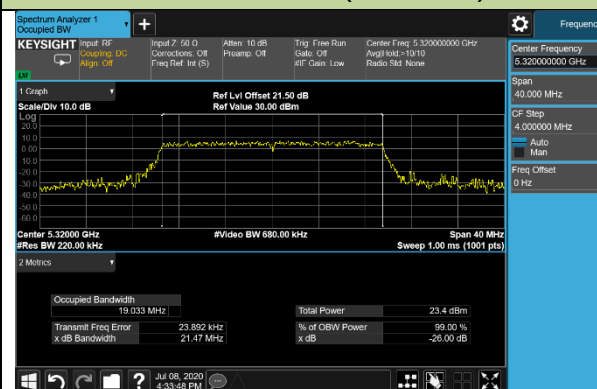
Channel 52 (5260MHz)



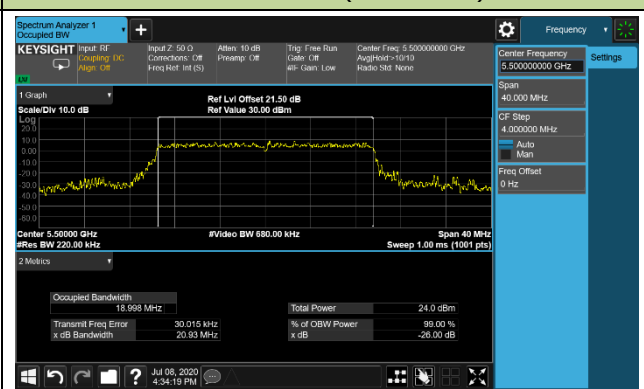
Channel 60 (5300MHz)



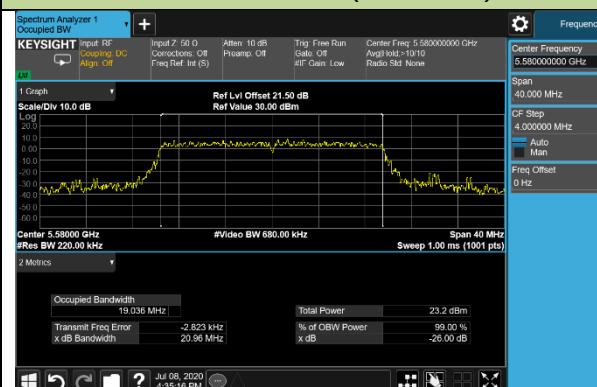
Channel 64 (5320MHz)



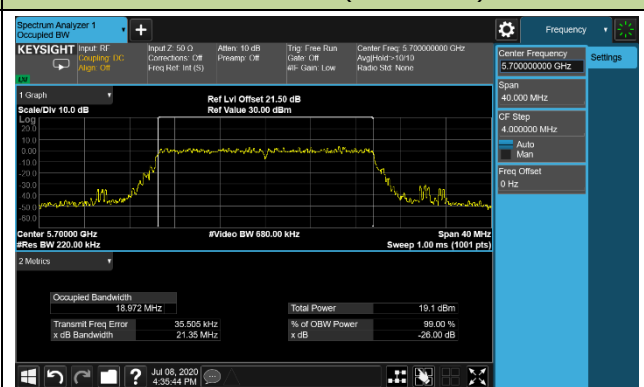
Channel 100 (5500MHz)



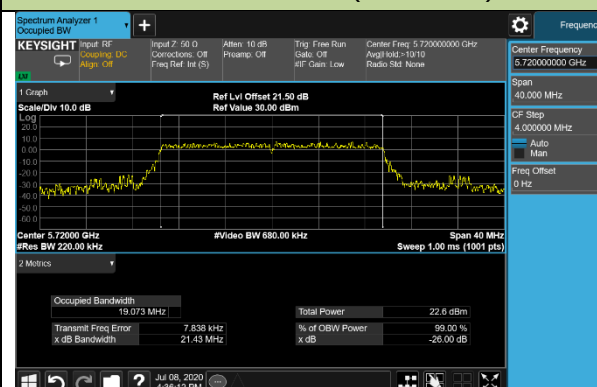
Channel 116 (5580MHz)



Channel 140 (5700MHz)

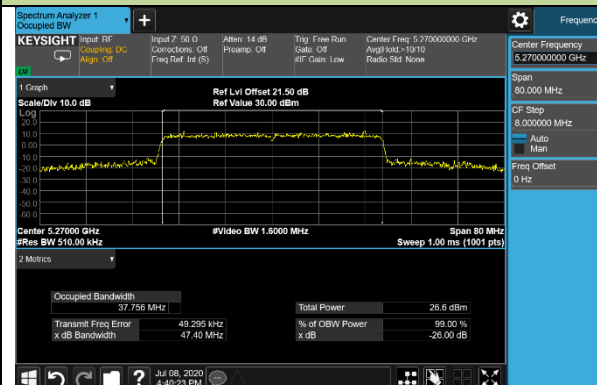


Channel 144 (5720MHz)

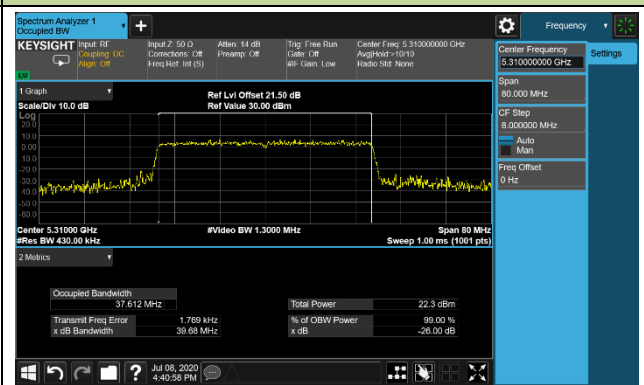


802.11ax-HE40 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

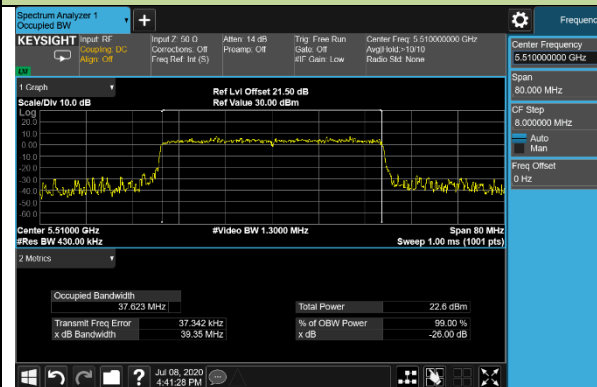
Channel 54 (5270MHz)



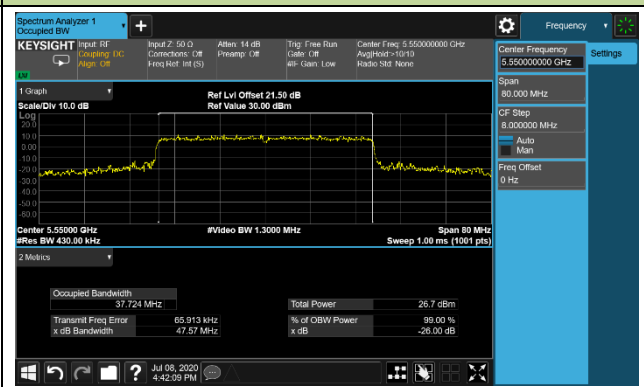
Channel 62 (5310MHz)



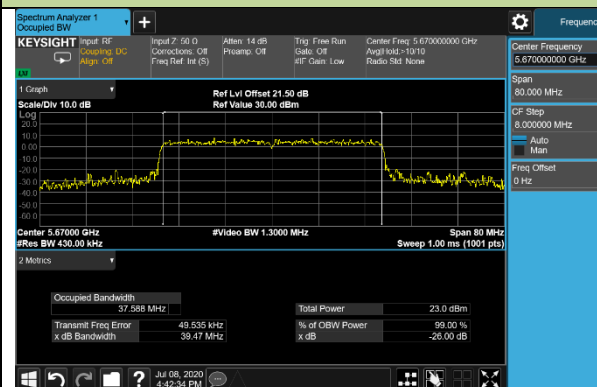
Channel 102 (5510MHz)



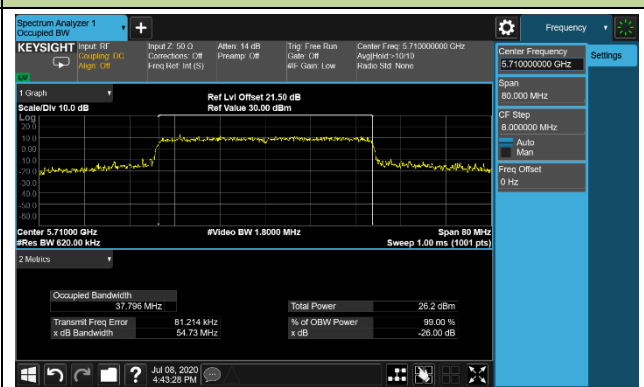
Channel 110 (5550MHz)



Channel 134 (5670MHz)

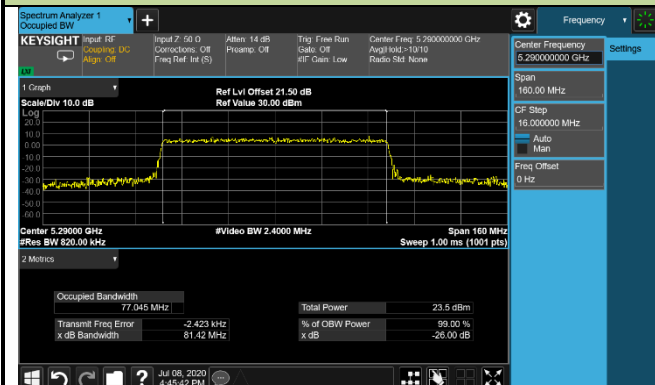


Channel 142 (5710MHz)

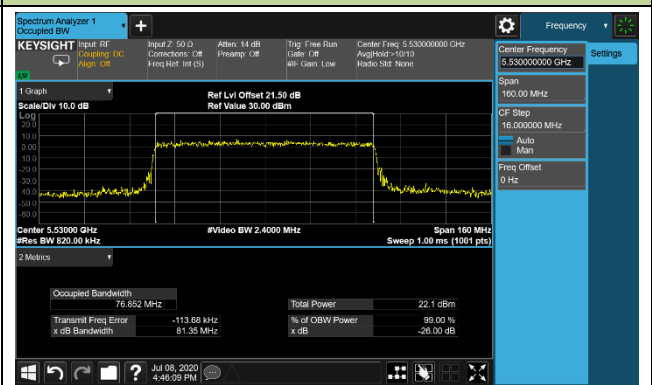


802.11ax-HE80 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1

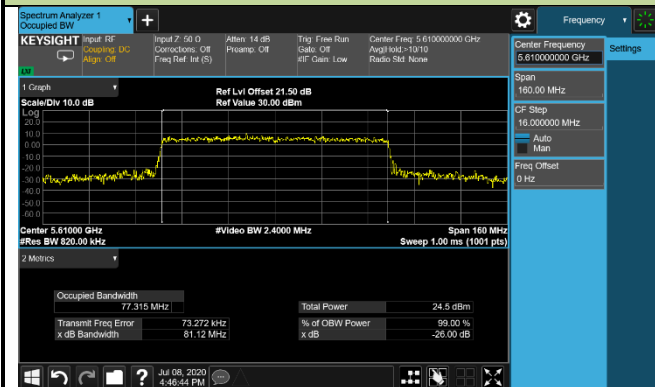
Channel 58 (5290MHz)



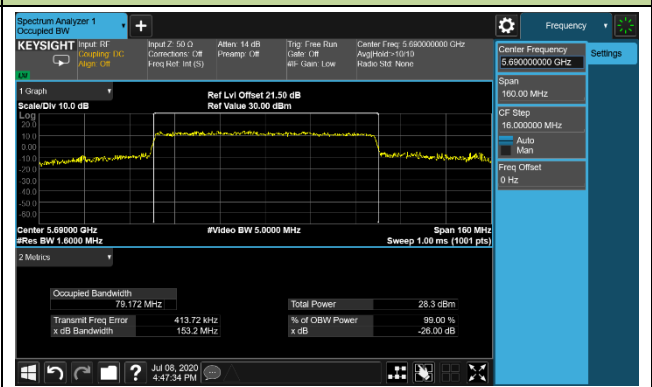
Channel 106 (5530MHz)



Channel 122 (5610MHz)



Channel 138 (5690MHz)



6.3. Output Power Measurement

6.3.1. Test Limit

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

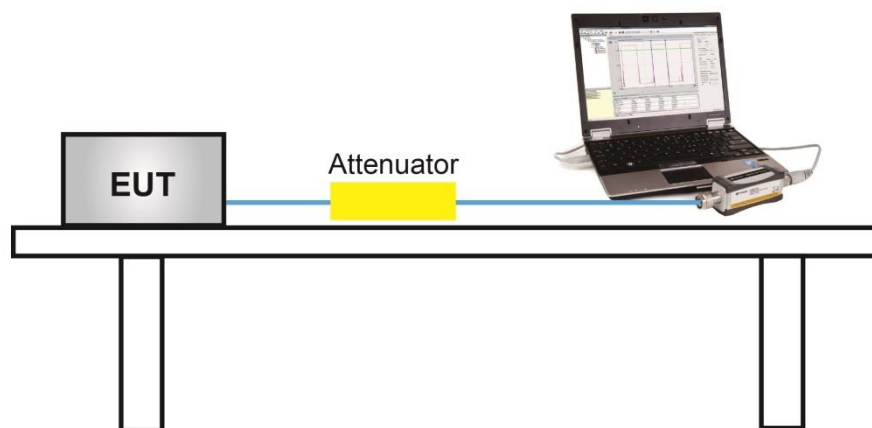
6.3.2. Test Procedure Used

KDB 789033D02v02r01- Section E)3)b) Method PM-G

6.3.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

6.3.4. Test Setup



6.3.5.Test Result

Product	AX1800 Wi-Fi 6 Range Extender	Test Engineer	Eric Lin
Test Site	SR1	Test Date	2020/06/28 ~ 2020/08/04
Test Mode	CDD Mode		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Average Power Limit (dBm)	Result
11a	6Mbps	52	5260	18.58	18.27	21.44	≤ 23.98	Pass
11a	6Mbps	60	5300	18.63	18.05	21.36	≤ 23.98	Pass
11a	6Mbps	64	5320	18.98	18.14	21.59	≤ 23.98	Pass
11a	6Mbps	100	5500	17.67	17.72	20.71	≤ 23.98	Pass
11a	6Mbps	116	5580	19.03	18.54	21.80	≤ 23.98	Pass
11a	6Mbps	140	5700	14.93	14.83	17.89	≤ 23.98	Pass
11a	6Mbps	144	5720	18.63	18.54	21.60	≤ 22.87	Pass
11ac-VHT20	MCS0	52	5260	19.07	18.88	21.99	≤ 23.98	Pass
11ac-VHT20	MCS0	60	5300	19.10	18.79	21.96	≤ 23.98	Pass
11ac-VHT20	MCS0	64	5320	18.88	18.72	21.81	≤ 23.98	Pass
11ac-VHT20	MCS0	100	5500	19.33	18.52	21.95	≤ 23.98	Pass
11ac-VHT20	MCS0	116	5580	18.59	18.79	21.70	≤ 23.98	Pass
11ac-VHT20	MCS0	140	5700	15.64	15.74	18.70	≤ 23.98	Pass
11ac-VHT20	MCS0	144	5720	18.73	18.54	21.65	≤ 22.88	Pass
11ac-VHT40	MCS0	54	5270	21.00	20.38	23.71	≤ 23.98	Pass
11ac-VHT40	MCS0	62	5310	16.38	16.00	19.20	≤ 23.98	Pass
11ac-VHT40	MCS0	102	5510	15.17	15.38	18.29	≤ 23.98	Pass
11ac-VHT40	MCS0	110	5550	19.60	19.82	22.72	≤ 23.98	Pass
11ac-VHT40	MCS0	134	5670	17.71	17.10	20.43	≤ 23.98	Pass
11ac-VHT40	MCS0	142	5710	19.61	18.79	22.23	≤ 23.98	Pass
11ac-VHT80	MCS0	58	5290	16.21	16.17	19.20	≤ 23.98	Pass
11ac-VHT80	MCS0	106	5530	15.88	16.32	19.12	≤ 23.98	Pass
11ac-VHT80	MCS0	122	5610	20.02	20.06	23.05	≤ 23.98	Pass
11ac-VHT80	MCS0	138	5690	20.98	20.56	23.79	≤ 23.98	Pass

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Average Power Limit (dBm)	Result
11ax-HE20	MCS0	52	5260	19.79	19.48	22.65	≤ 23.98	Pass
11ax-HE20	MCS0	60	5300	19.65	19.28	22.48	≤ 23.98	Pass
11ax-HE20	MCS0	64	5320	19.27	19.03	22.16	≤ 23.98	Pass
11ax-HE20	MCS0	100	5500	19.67	18.71	22.23	≤ 23.98	Pass
11ax-HE20	MCS0	116	5580	19.67	19.21	22.46	≤ 23.98	Pass
11ax-HE20	MCS0	140	5700	13.58	13.42	16.51	≤ 23.98	Pass
11ax-HE20	MCS0	144	5720	19.37	19.24	22.32	≤ 22.96	Pass
11ax-HE40	MCS0	54	5270	21.09	20.54	23.83	≤ 23.98	Pass
11ax-HE40	MCS0	62	5310	16.60	16.21	19.42	≤ 23.98	Pass
11ax-HE40	MCS0	102	5510	15.80	15.57	18.70	≤ 23.98	Pass
11ax-HE40	MCS0	110	5550	19.64	19.77	22.72	≤ 23.98	Pass
11ax-HE40	MCS0	134	5670	17.53	16.95	20.26	≤ 23.98	Pass
11ax-HE40	MCS0	142	5710	20.07	19.51	22.81	≤ 23.98	Pass
11ax-HE80	MCS0	58	5290	16.46	16.06	19.27	≤ 23.98	Pass
11ax-HE80	MCS0	106	5530	14.88	15.15	18.03	≤ 23.98	Pass
11ax-HE80	MCS0	122	5610	17.85	17.37	20.63	≤ 23.98	Pass
11ax-HE80	MCS0	138	5690	20.93	20.31	23.64	≤ 23.98	Pass

Note 1: Total Average Power (dBm) = $10 \cdot \log \{10^{(\text{Ant 0 Average Power} / 10)} + 10^{(\text{Ant 1 Average Power} / 10)}\}$.

Note 2: Average Power Limit Calculation as below:

802.11a/ac-VHT20/ac-VHT40/ac-VHT80/ax-HE20/ax-HE40/ax-HE80: Limit = 23.98dBm.

For Channel 144 (5720MHz), $11 + 10 \cdot \log (5\text{MHz} + \text{BW}_{26\text{dBc}}/2) < 23.98\text{dBm}$

Product	AX1800 Wi-Fi 6 Range Extender	Test Engineer	Eric Lin
Test Site	SR1	Test Date	2020/06/28 ~ 2020/08/04
Test Mode	Beamforming Mode		

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Average Power Limit (dBm)	Result
11ac-VHT20	MCS0	52	5260	19.07	18.88	21.99	≤ 23.98	Pass
11ac-VHT20	MCS0	60	5300	19.10	18.79	21.96	≤ 23.98	Pass
11ac-VHT20	MCS0	64	5320	18.88	18.72	21.81	≤ 23.98	Pass
11ac-VHT20	MCS0	100	5500	19.33	18.52	21.95	≤ 23.98	Pass
11ac-VHT20	MCS0	116	5580	18.59	18.79	21.70	≤ 23.98	Pass
11ac-VHT20	MCS0	140	5700	12.49	12.01	15.27	≤ 23.98	Pass
11ac-VHT20	MCS0	144	5720	18.73	18.54	21.65	≤ 22.88	Pass
11ac-VHT40	MCS0	54	5270	21.00	20.38	23.71	≤ 23.98	Pass
11ac-VHT40	MCS0	62	5310	13.15	13.09	16.13	≤ 23.98	Pass
11ac-VHT40	MCS0	102	5510	12.16	12.47	15.33	≤ 23.98	Pass
11ac-VHT40	MCS0	110	5550	19.60	19.82	22.72	≤ 23.98	Pass
11ac-VHT40	MCS0	134	5670	12.27	12.16	15.23	≤ 23.98	Pass
11ac-VHT40	MCS0	142	5710	19.61	18.79	22.23	≤ 23.98	Pass
11ac-VHT80	MCS0	58	5290	11.53	11.01	14.29	≤ 23.98	Pass
11ac-VHT80	MCS0	106	5530	11.42	11.03	14.24	≤ 23.98	Pass
11ac-VHT80	MCS0	122	5610	13.27	13.23	16.26	≤ 23.98	Pass
11ac-VHT80	MCS0	138	5690	20.98	20.56	23.79	≤ 23.98	Pass
11ax-HE20	MCS0	52	5260	19.79	19.48	22.65	≤ 23.98	Pass
11ax-HE20	MCS0	60	5300	19.65	19.28	22.48	≤ 23.98	Pass
11ax-HE20	MCS0	64	5320	19.27	19.03	22.16	≤ 23.98	Pass
11ax-HE20	MCS0	100	5500	19.67	18.71	22.23	≤ 23.98	Pass
11ax-HE20	MCS0	116	5580	19.67	19.21	22.46	≤ 23.98	Pass
11ax-HE20	MCS0	140	5700	13.58	13.42	16.51	≤ 23.98	Pass
11ax-HE20	MCS0	144	5720	19.37	19.24	22.32	≤ 22.96	Pass

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Average Power Limit (dBm)	Result
11ax-HE40	MCS0	54	5270	21.09	20.54	23.83	≤ 23.98	Pass
11ax-HE40	MCS0	62	5310	12.05	11.22	14.67	≤ 23.98	Pass
11ax-HE40	MCS0	102	5510	11.17	11.03	14.11	≤ 23.98	Pass
11ax-HE40	MCS0	110	5550	19.64	19.77	22.72	≤ 23.98	Pass
11ax-HE40	MCS0	134	5670	12.02	11.95	15.00	≤ 23.98	Pass
11ax-HE40	MCS0	142	5710	20.07	19.51	22.81	≤ 23.98	Pass
11ax-HE80	MCS0	58	5290	10.53	10.27	13.41	≤ 23.98	Pass
11ax-HE80	MCS0	106	5530	10.86	10.53	13.71	≤ 23.98	Pass
11ax-HE80	MCS0	122	5610	13.54	13.17	16.37	≤ 23.98	Pass
11ax-HE80	MCS0	138	5690	20.93	20.31	23.64	≤ 23.98	Pass

Note 1: Total Average Power (dBm) = $10 \cdot \log \{10^{(\text{Ant 0 Average Power} / 10)} + 10^{(\text{Ant 1 Average Power} / 10)}\}$.

Note 2: Average Power Limit Calculation as below:

802.11ac-VHT20/ac-VHT40/ac-VHT80/ax-HE20/ax-HE40/ax-HE80: Limit = 23.98dBm.

For Channel 144 (5720MHz), $11 + 10 \cdot \log (5\text{MHz} + \text{BW}_{26\text{dBc}}/2) < 23.98\text{dBm}$

6.4. Transmit Power Control

6.4.1. Test Limit

The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm.

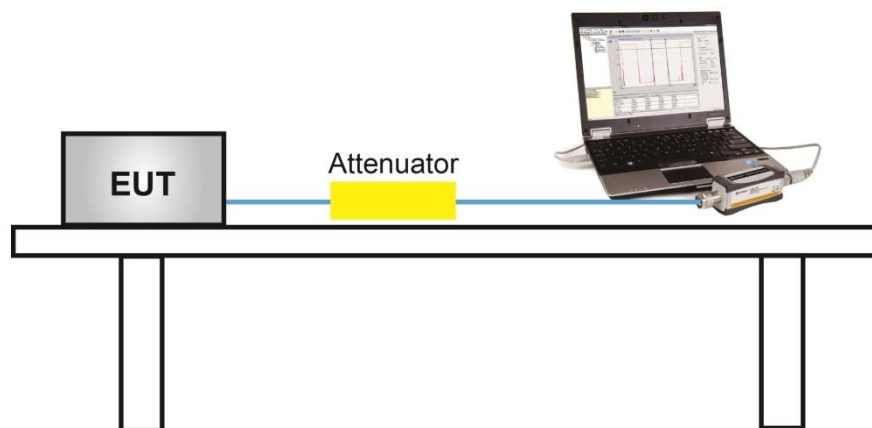
6.4.2. Test Procedure Used

KDB 789033 D02v01 - Section E) 3) b) Method PM-G

6.4.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

6.4.4. Test Setup



6.4.5. Test Result

Device supports TPC mechanism, details refer to the operational description.

6.5. Power Spectral Density Measurement

6.5.1. Test Limit

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

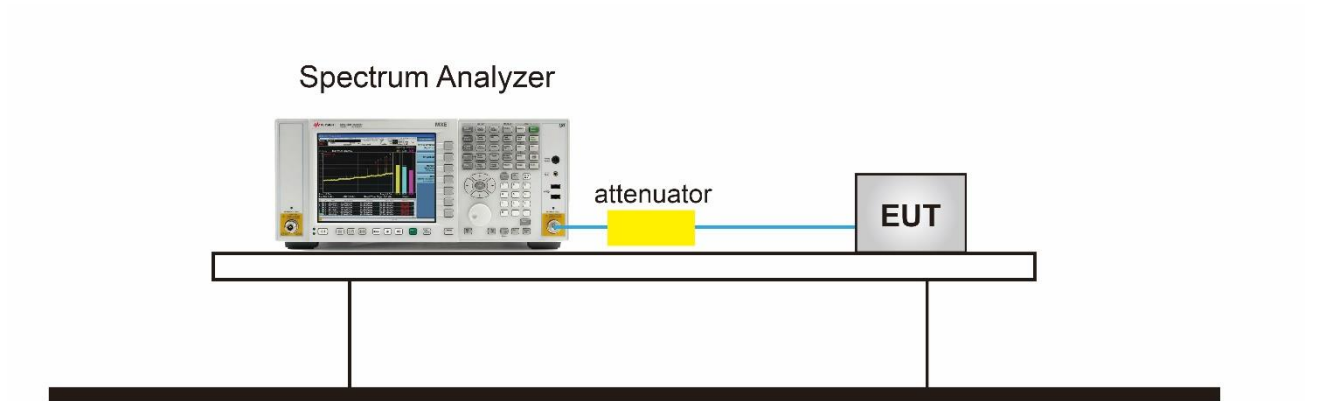
6.5.2. Test Procedure Used

KDB 789033 D02v02r01-Section F

6.5.3. Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz,
RBW = 510KHz
4. VBW $\geq$ 3RBW
5. Number of sweep points $\geq 2 \times (\text{span} / \text{RBW})$
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
10. Add $10 \cdot \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add $10 \cdot \log(1/0.25) = 6$ dB if the duty cycle is 25 percent.

6.5.4.Test Setup



6.5.5.Test Result

Product	AX1800 Wi-Fi 6 Range Extender	Test Engineer	Eric Lin
Test Site	SR1	Test Date	2020/06/28 ~ 2020/08/06
Test Item	Power Spectral Density (UNII-2a & UNII-2c Bands) – CDD mode		

Test Mode	Data Rate /MCS	Ch. No.	Freq. (MHz)	Ant 0 PSD (dBm/MHz)	Ant 1 PSD (dBm/MHz)	Duty Cycle (%)	Total PSD (dBm/ MHz)	PSD Limit (dBm/MHz)	Result
11a	6Mbps	52	5260	7.76	7.26	94.89	10.75	≤ 11.00	Pass
11a	6Mbps	60	5300	7.61	7.46	94.89	10.77	≤ 11.00	Pass
11a	6Mbps	64	5320	7.76	7.48	94.89	10.86	≤ 11.00	Pass
11a	6Mbps	100	5500	5.94	5.07	94.89	8.76	≤ 11.00	Pass
11a	6Mbps	116	5580	7.60	7.34	94.89	10.71	≤ 11.00	Pass
11a	6Mbps	140	5700	3.53	3.42	94.89	6.71	≤ 11.00	Pass
11a	6Mbps	144	5720	7.67	7.55	94.89	10.85	≤ 11.00	Pass
11ac-VHT20	MCS0	52	5260	7.72	7.48	97.86	10.71	≤ 11.00	Pass
11ac-VHT20	MCS0	60	5300	7.83	7.43	97.86	10.74	≤ 11.00	Pass
11ac-VHT20	MCS0	64	5320	7.82	7.42	97.86	10.73	≤ 11.00	Pass
11ac-VHT20	MCS0	100	5500	7.78	7.49	97.86	10.74	≤ 11.00	Pass
11ac-VHT20	MCS0	116	5580	7.51	7.61	97.86	10.67	≤ 11.00	Pass
11ac-VHT20	MCS0	140	5700	4.70	4.57	97.86	7.74	≤ 11.00	Pass
11ac-VHT20	MCS0	144	5720	7.47	7.68	97.86	10.68	≤ 11.00	Pass
11ac-VHT40	MCS0	54	5270	5.55	5.32	95.59	8.64	≤ 11.00	Pass
11ac-VHT40	MCS0	62	5310	2.08	1.63	95.59	5.07	≤ 11.00	Pass
11ac-VHT40	MCS0	102	5510	0.93	1.02	95.59	4.18	≤ 11.00	Pass
11ac-VHT40	MCS0	110	5550	5.40	5.50	95.59	8.66	≤ 11.00	Pass
11ac-VHT40	MCS0	134	5670	3.35	2.66	95.59	6.22	≤ 11.00	Pass
11ac-VHT40	MCS0	142	5710	5.69	5.29	95.59	8.70	≤ 11.00	Pass
11ac-VHT80	MCS0	58	5290	-1.10	-1.23	93.87	2.12	≤ 11.00	Pass
11ac-VHT80	MCS0	106	5530	-1.37	-1.26	93.87	1.97	≤ 11.00	Pass
11ac-VHT80	MCS0	122	5610	2.86	2.92	93.87	6.18	≤ 11.00	Pass
11ac-VHT80	MCS0	138	5690	3.55	3.18	93.87	6.66	≤ 11.00	Pass

Test Mode	Data Rate /MCS	Ch. No.	Freq. (MHz)	Ant 0 PSD (dBm/MHz)	Ant 1 PSD (dBm/MHz)	Duty Cycle (%)	Total PSD (dBm/ MHz)	PSD Limit (dBm/MHz)	Result
11ax-HE20	MCS0	52	5260	7.79	7.74	98.05	10.78	≤ 11.00	Pass
11ax-HE20	MCS0	60	5300	7.99	7.56	98.05	10.79	≤ 11.00	Pass
11ax-HE20	MCS0	64	5320	7.94	7.49	98.05	10.73	≤ 11.00	Pass
11ax-HE20	MCS0	100	5500	8.26	7.52	98.05	10.91	≤ 11.00	Pass
11ax-HE20	MCS0	116	5580	8.06	7.44	98.05	10.77	≤ 11.00	Pass
11ax-HE20	MCS0	140	5700	2.38	2.26	98.05	5.33	≤ 11.00	Pass
11ax-HE20	MCS0	144	5720	7.84	7.75	98.05	10.80	≤ 11.00	Pass
11ax-HE40	MCS0	54	5270	5.74	5.24	95.98	8.68	≤ 11.00	Pass
11ax-HE40	MCS0	62	5310	2.41	1.76	95.98	5.29	≤ 11.00	Pass
11ax-HE40	MCS0	102	5510	1.70	1.31	95.98	4.69	≤ 11.00	Pass
11ax-HE40	MCS0	110	5550	5.39	5.25	95.98	8.51	≤ 11.00	Pass
11ax-HE40	MCS0	134	5670	3.37	2.74	95.98	6.25	≤ 11.00	Pass
11ax-HE40	MCS0	142	5710	6.02	5.34	95.98	8.88	≤ 11.00	Pass
11ax-HE80	MCS0	58	5290	-0.67	-1.16	92.58	2.44	≤ 11.00	Pass
11ax-HE80	MCS0	106	5530	-2.11	-2.17	92.58	1.21	≤ 11.00	Pass
11ax-HE80	MCS0	122	5610	0.83	0.74	92.58	4.13	≤ 11.00	Pass
11ax-HE80	MCS0	138	5690	3.73	3.54	92.58	6.98	≤ 11.00	Pass

Note 1:

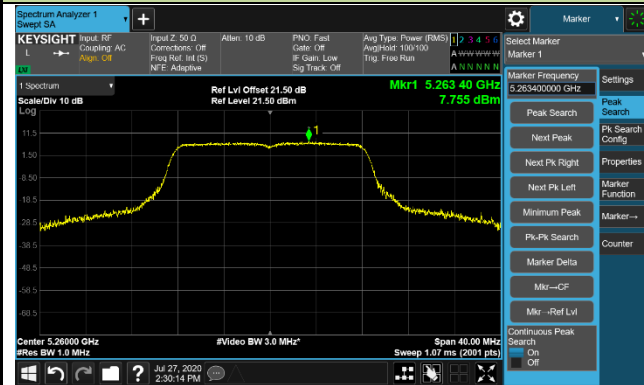
When EUT duty cycle > 98%, the total PSD (dBm/MHz) = $10 \cdot \log \{10^{(\text{Ant 0 PSD}/10)} + 10^{(\text{Ant 1 PSD}/10)}\}$ (dBm/MHz).

When EUT duty cycle < 98%, the total PSD (dBm/MHz) = $10 \cdot \log \{10^{(\text{Ant 0 PSD}/10)} + 10^{(\text{Ant 1 PSD}/10)}\}$ (dBm/MHz) + $10 \cdot \log (1/\text{Duty Cycle})$.

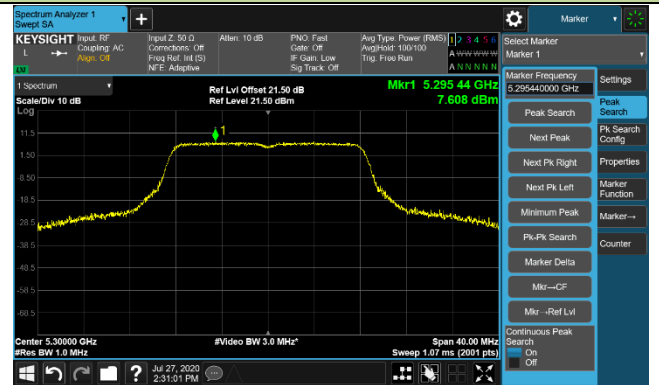
Note 2: Due to the power setting of beamforming mode is not great than CDD mode, so beamforming mode result is not reported.

802.11a Power Spectral Density - Ant 0 / Ant 0 + 1 (CDD Mode)

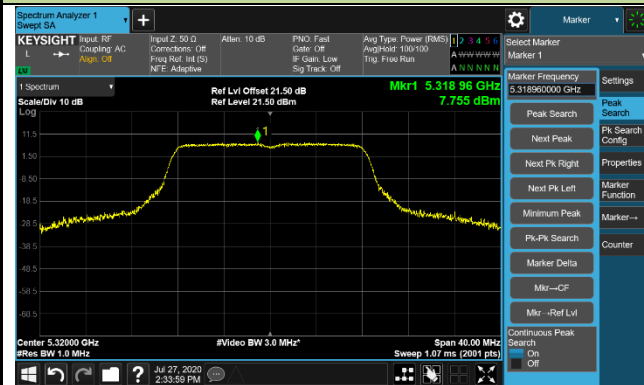
Channel 52 (5260MHz)



Channel 60 (5300MHz)



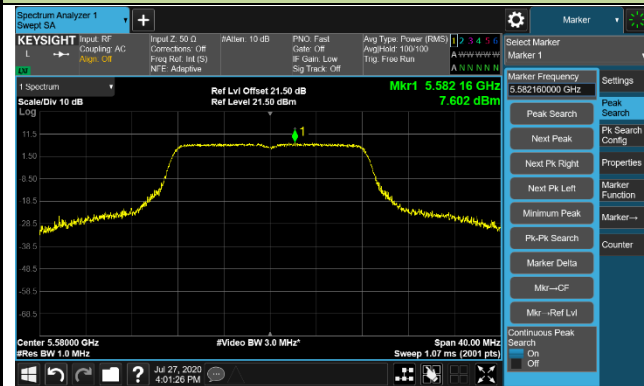
Channel 64 (5320MHz)



Channel 100 (5500MHz)



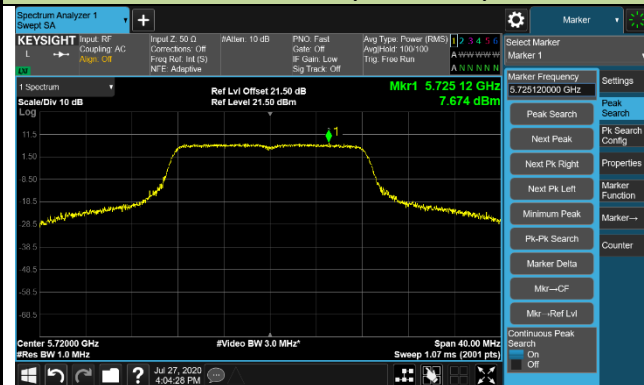
Channel 116 (5580MHz)



Channel 140 (5700MHz)

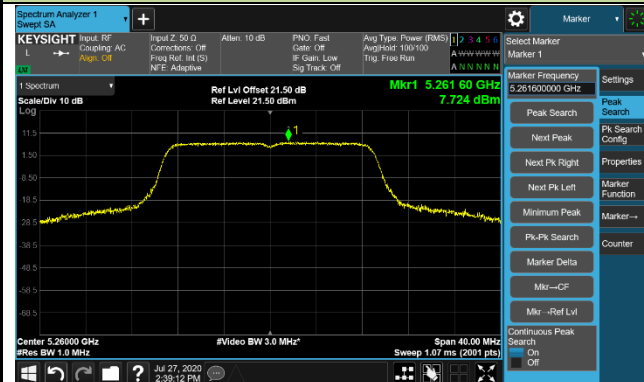


Channel 144 (5720MHz)



802.11ac-VHT20 Power Spectral Density - Ant 0 / Ant 0 + 1 (CDD Mode)

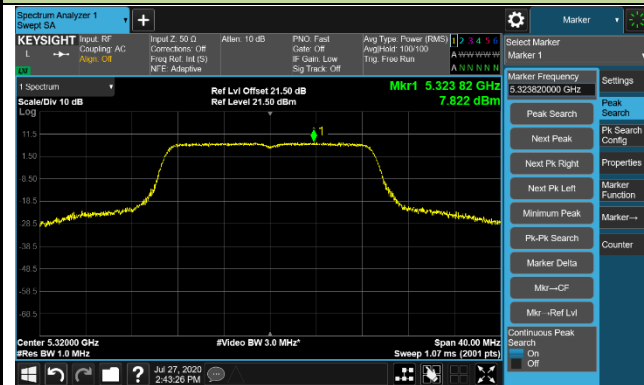
Channel 52 (5260MHz)



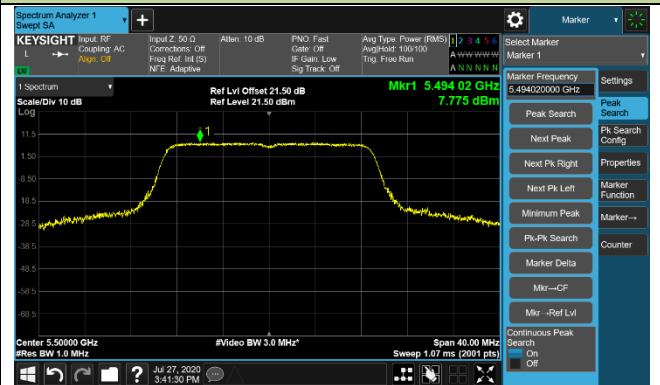
Channel 60 (5300MHz)



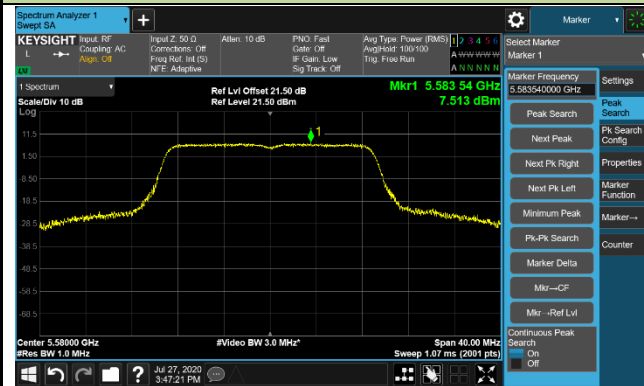
Channel 64 (5320MHz)



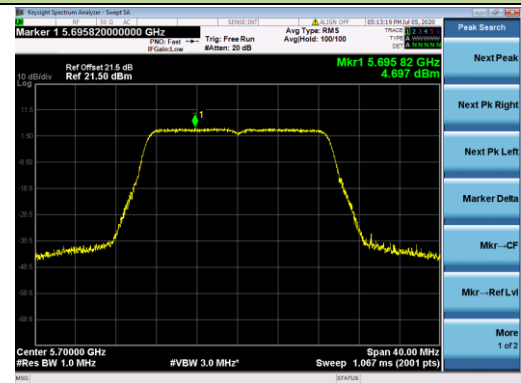
Channel 100 (5500MHz)



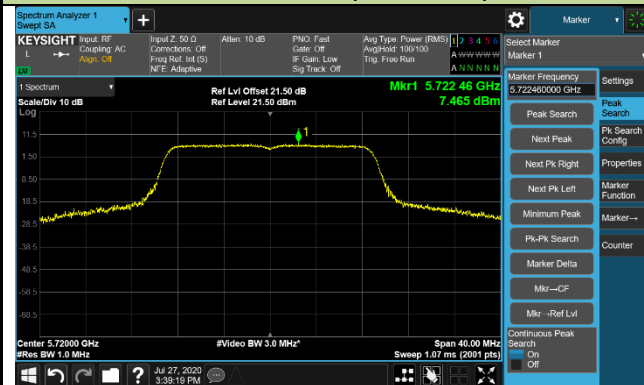
Channel 116 (5580MHz)



Channel 140 (5700MHz)

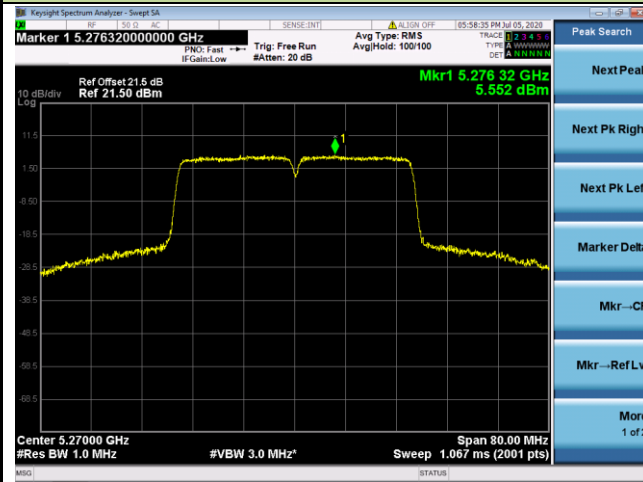


Channel 144 (5720MHz)

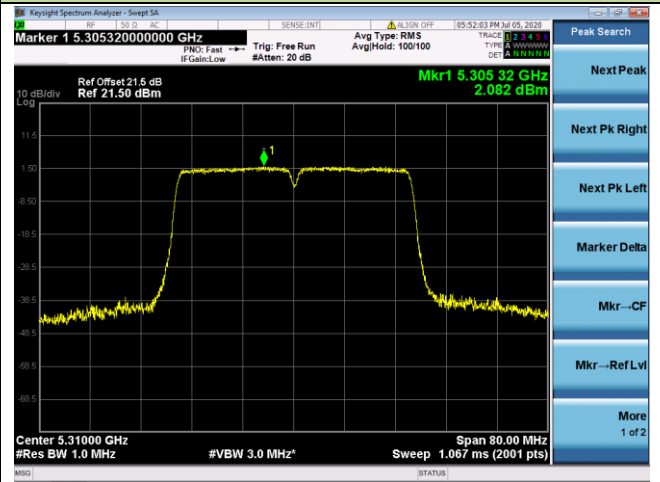


802.11ac-VHT40 Power Spectral Density - Ant 0 / Ant 0 + 1 (CDD Mode)

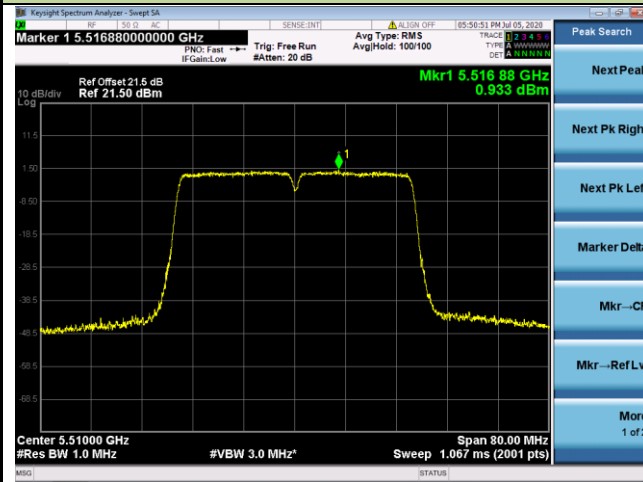
Channel 54 (5270MHz)



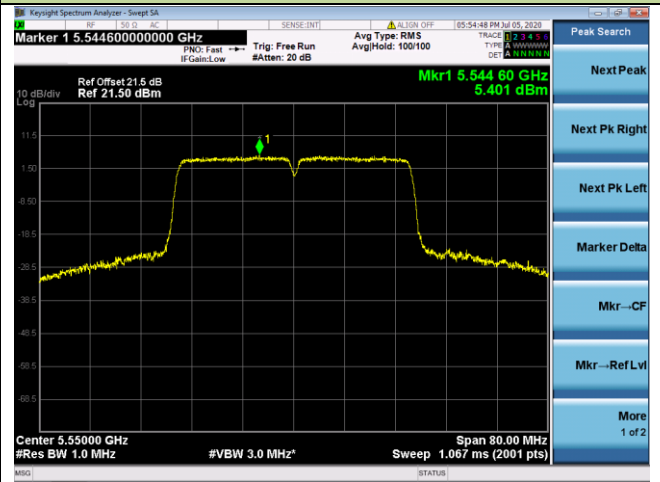
Channel 62 (5310MHz)



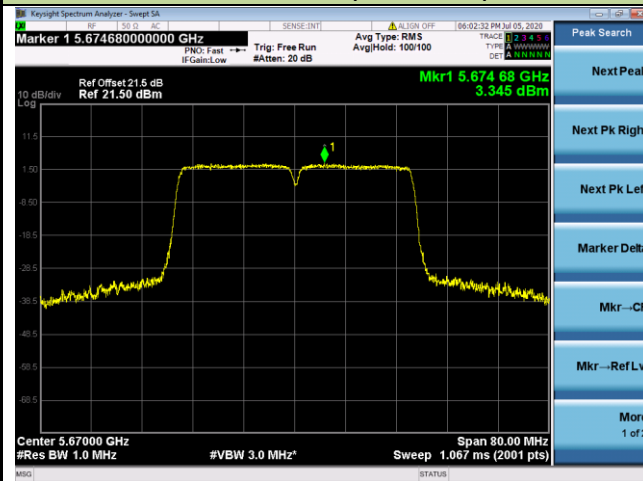
Channel 102 (5510MHz)



Channel 110 (5550MHz)



Channel 134 (5670MHz)



Channel 142 (5710MHz)

